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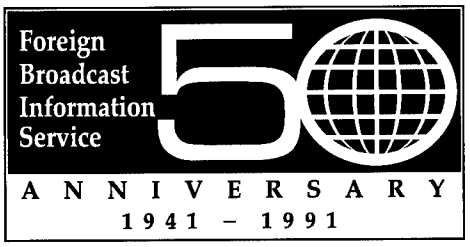

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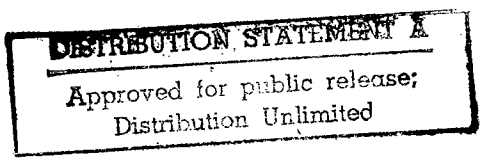

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Quasioptical Gyrotron With Three-Reflector Telescopic Resonator

917F0330A Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: FIZIKA, ASTRONOMIYA in Russian Vol 32 No 2, Mar-Apr 91 pp 23-28

[Article by A.I. Kostiyenko, A.F. Korolev, V.M. Pereshein, Radiophysics Department]

UDC 621.385.6.029.6

[Abstract] A quasioptical gyrotron - a powerful source of millimeter and submillimeter band radiation - and its advantages over conventional gyrotrons, viz., a high volume of interaction making it possible to attain a higher power density at a relatively low energy density and the possibility of shortening the stimulated radiation wavelength significantly by manipulating the magnetic field strength or using cyclotron resonance harmonic modes are summarized. It is shown that despite these advantages, the gyrotron's efficiency (KPD) does not exceed 17-20%. A two-resonator quasioptical gyroklystron intended to overcoming these problems and its drawbacks are described. A new quasioptical gyrotron configuration developed by the authors by optimizing the energy transfer, numerically examining various high-frequency field distributions, and developing appropriate resonators for optimal distributions is presented. In particular, the new three-reflector telescopic resonators are designed on the basis of the results of mathematical simulation of the electron beam interaction with the electromagnetic field in the quasioptical gyrotron. The high-frequency field distribution in the resonator makes it possible to reach an optimal beam→field energy transfer whereby up to 90% of the beam's transverse energy is converted into the electromagnetic field energy. References 12; figures 4.

Determining Spectral Function of Refractive Index of Suspended Particles by Measuring Scattered Radiation Characteristics

917F0327C Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 54 No 1, Jan 91 pp 113-119

[Article by S.L. Oshchepkov, Physics Institute imeni B.I. Stepanov at the Belorussian Academy of Sciences, Minsk]

UDC 535.36

[Abstract] Measurements of optical constants of particles suspended in natural reservoirs *in situ* from the viewpoint of identifying the suspension composition indirectly and obtaining *a priori* data for solving "limited" inverse problems of hydrosol light scattering are discussed. A proximate method of measuring the refractive index of substances in finely dispersed sea suspension components from light scattering characteristics with a minimum of *a priori* data on its microstructure is developed. The study is carried out on the basis of model calculations using Mie's formulae within the ranges of optical constants and suspension microstructure parameter measurements cited in *Okeanologiya* Vol 28 No 1, 1988, pp. 168-172. Theoretical data are compared to the results of full-scale experiments carried out in the deep-water Tonga trench. The study demonstrates the expediency of parallel reconstruction of refractive indices of substance particles by means of solving the limited inverse hydrosol light scattering problem. References 6: 5 Russian, 1 Western; figures 2; tables 2.

Continuous Iodine-129 Impurity Monitoring in Special Atmosphere by Laser Induced Luminescence Method

917F0327B Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 54 No 1, Jan 91 pp 88-91

[Article by Yu.P. Zaspa, S.V. Kireyev, Ye.D. Protsenko, V.K. Veselov, V.K. Isupov, Moscow Engineering Physics Institute and 'Radiyevyy Institut' Scientific Production Association, Leningrad]

UDC 535.37:543.426+621.039

[Abstract] Methods of continuously monitoring spent fuel products at nuclear power plants (AES), especially molecular ^{129}I isotope whose low γ- and β-activity make it difficult to detect it continuously in gaseous fuel dissolution products by radiometry methods, are considered. The use of analytical laser spectroscopy methods and particularly the fluorescence method is examined. The results of laser fluorescence analysis of iodine-129 impurities in gaseous products of pilot processing of irradiated nuclear power plant fuel are presented. The spent nuclear samples used had a more than three year exposure and contained only two iodine isotopes, ^{129}I and ^{127}I while the former was dominant (≈86%). The pilot unit design is presented. It is shown that the method makes it possible to monitor continuously ^{129}I impurities in the gaseous phase of nitric acid spent nuclear fuel dissolution products and estimate the effect of nitrogen dioxide and other components on the fluorescence signal level. The method's sensitivity is close to 1 mg/m^3. The authors are grateful to I.O. Lashchevskiy for help with organizing ^{85}Kr detection used for reference and I.A. Yakovlev for technical assistance with the experiment. References 6: 4 Russian, 2 Western; figures 2.

Optical ^{60}Co γ-Radiation Dosimetry Method on LiF:OH^- Crystals

917F0327D Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 54 No 1, Jan 91 pp 160-161

[Article by P.D. Alekseyev, V.I. Dubovik, Omsk State University]

UDC 548:535.343.2

[Abstract] The use of optical spectroscopy for ionizing radiation monitoring by recording absorption bands in the ultraviolet (UV) and visible spectra is discussed and method of extending optical radiation monitoring applications to the middle infrared (IR) region by using LiF crystals doped with OH^- ions is proposed. Experimental data are cited for a certain OH^- ion concentration found from infrared transmission spectra based on absorptance at the line peak of 3,730 cm^{-1}. The crystals were irradiated by a ^{60}Co source in an Issledovatel unit; infrared spectra in the 4,200-400 cm^{-1} band were recorded by an IKS-29 spectrophotometer. Radiation-induced centers with molecular bonds peaking in the crystal at 3,060 (I) and 2,130-2,145 (II) cm^{-1} under the effect of γ-radiation were recorded in the infrared transmission spectrum. The crystal was annealed at 690-720°C for 30 min and quenched to room temperature, making it possible to return the crystal to the initial state and reuse it (virtually indefinitely) for determining the unknown γ-radiation power by calibration curves and exposure time. It is noted that infrared spectral of γ-irradiated crystals maintain dosimetry data for a year accurately within 7% while the radiation meter readings do not depend on the γ-radiation dose within the 10^3-10^4 gR/h range. It is shown that the proposed γ-radiation monitoring method is simpler, cheaper, more reliable, and faster than other known methods. References 2; figures 1.

Remote Detection of Mercury Atoms in Atmosphere by Laser; Differential Absorption Method

917F0327A Minsk ZHURNAL PRIKLADNOY SPEKTROSKOPII in Russian Vol 54 No 1, Jan 91 pp 60-68

[Article by S.Ye. Sholupov, A.A. Ganeyev, O.I. Matveyev, G.B. Sveshnikov, Yu.I. Turkin, Leningrad State University]

UDC 543.42

[Abstract] The differential absorption and scattering (DPR) method used for studying the spatial distribution of atom concentration in lower layers of the atmosphere by lasers whereby lidar signals recorded in two rather narrow spectral bands one of which is in the central absorption line contour and the other, in the weak absorption area, is examined. One particular version of the differential method, i.e., using a laser whose emission line contour is wider than the mercury absorption line contour in the air, is considered. In this case a portion of laser radiation whose frequency coincides with the mercury absorption line frequency falls within the strong absorption area and serves as analytical emission while the remaining part falling outside the absorption contour serves as reference emission. The lidar equation in the approximation of single laser radiation scattering in the atmosphere with a short laser pulse duration is derived. Photodetector circuits designs with photomultipliers (FEU) and resonance-ionization detectors (RID) are analyzed. The calibration curve is cited and laser detection threshold, detection range, and recording accuracy are estimated. Experiments with a 1-10 mJ/pulse laser pulses at the $\lambda = 245$ nm mercury resonance wavelength made it possible to detect mercury concentrations from a $3x10^6$ cm^{-3} background level to a $3x10^{10}$ cm^{-3} abnormal level over a 1 km range with a 100 m resolution. References 6: 5 Russian, 1 Western; figures 4.

Accuracy of Flat Optics Surface Forming by 'Aquapol' Tool

917F0351A Kiev SVERKHTVERDYYE MATERIALY in Russian No 3 (72), May-Jun 91 pp 54-58

[Article by Yu.D. Filatov, V.V. Rogov, N.D. Rublev, I.V. Drakin, M.N. Prikhno, O.N. Rublev, S.D. Tausnev, V.D. Sakhno, Superhard Materials Institute at the Ukrainian Academy of Sciences and Feodosiya Optics Plant]

UDC 621.923:666.227.3

[Abstract] The process of spherical movie and photo camera optic surface polishing with the help of the Aquapol tool which ensures a polished surface roughness of 0.05 μm, an optical surface finish of RIII-RIV (according to state standard GOST 11141-84), and machining accuracy within 3-5 interference rings is described. A technique for designing the Aquapol abrasive layer for polishing flat optics surfaces is presented. The polished surface forming accuracy can be controlled by manipulating the tool's working layer design thus controlling its wear. The use of the method makes it possible to attain a very high sphere surface forming accuracy and thus completely eliminate the tool's working surface dressing. It is shown that in polishing, one must take into account the effect of the pressure distribution along the circular zone radius of the upper link on the forming character of mutually lapping surfaces of the tool and the optics in contrast to the grinding process. It is also shown that for given polishing conditions and kinematic parameters, a tool's working layer design can always be developed so as to ensure a high stability and accuracy of flat optics forming. References 11; figures 2; tables 1.

Diamond Microturning of Precision Optics Surfaces From Nonmetallic Materials (Review). Part 2

917F0351B Kiev SVERKHTVERDYYE MATERIALY in Russian No 3 (72), May-Jun 91 pp 59-64

[Article by V.I. Sidorko, L.L. Burman, F.M. Vaserman, Superhard Materials Institute at the Ukrainian Academy of Sciences, Kiev]

UDC 621.0.01

[Abstract] Characteristic features of the method of diamond microturning of nonmetallic materials, primarily optics surfaces, as reported in foreign and domestic publications were reviewed in *Sverkhtverdyye materialy* No. 2, 1991. Part 2 of the review is devoted to considering the requirements being imposed on the cutting tool, the factors which determine the quality and accuracy of optics surfaces produced by diamond microturning, and methods of monitoring its parameters. It is shown that single crystal diamond which has a range of unique physical characteristics meets most fully the requirements imposed on single-blade cutting tools for microturning. The analysis makes it possible to draw the conclusion that despite the high volume of technical, production, and economic data on the use of diamond microturning of nonmetal materials, primarily optics surfaces, the phenomena occurring during the cutting process and the principal patterns of the process remain virtually unknown, thus necessitating further studies in this field. It is also stressed that contact transducers are virtually useless for measuring the surface roughness during the diamond microturning. References 30: 6 Russian, 24 Western; figures 2.

Determining Optimum Tool Shape for Polishing Flat Optics Surfaces

917F0336A Minsk TRENIYE I IZNOS in Russian Vol 12 No 3, May-Jun 91 pp 452-458

[Article by Yu.D. Filatov, Superhard Materials Institute at the Ukrainian Academy of Sciences, Kiev]

UDC 621.762:539.638

[Abstract] The use of the Aquapol tool for polishing spherical optics surfaces with class RIII-RIV optical finish (GOST 11141-84) is reported and the need to develop a more efficient tool design for polishing flat optics surfaces is identified. The patterns of flat surface forming during polishing and conditions for ensuring a high forming stability of a flat optics surface are discussed; it is shown that the latter call for ensuring the planeness of the tool's working surface and its equal wear during the polishing. A method which meets these conditions was designed and tested; it ensured a surface finish accuracy within 3-5 interference rings. The performance of tools with new types of abrasive layer and concentric working elements is compared; it is shown that tools with the newly designed abrasive layer are characterized by a more even wear than those with concentric elements. Thus, the tool designed according to the new method which takes into account the pressure distribution and kinematic parameters of the tool setting (assuming that the upper element rotation is needed only to ensure that all lapping surface segments take part in the polishing process that that the element friction path on the machined surface is determined only by its filling of the circular zones) is capable of making accurate flat optics surfaces with either top or bottom positioning of the abrasive element. The tool is characterized by uniform wear during the polishing and maintains the planar shape of its working surface for a long time which is both the necessary and sufficient condition for accurate forming of flat optics surfaces. References 12; figures 3; tables 3.

Minatomenergoprom Joint Expedition Head Yu.S. Cherepin Interviewed

917F0320A Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 1 Jun 91 p 4

[Interview by Sergey Kuts with Yuriy Semenovich Cherepin, head of the joint expedition of the Ministry of the Nuclear Power Generation Industry; dateline Kurchatov/Alma-Ata; first paragraph is boxed source introduction; final three paragraphs are boldface source-supplied conclusion; interview published under the "Timely Interview" rubric: "Safety Coordinates"]

[Text] I made Yuriy Semenovich Cherepin's acquaintance at the Semipalatinsk proving ground. He is the head of what has been termed the joint expedition of the Ministry of the Nuclear Power Generation Industry [Minatomenergoprom]. What is a joint expedition? It was simple when nothing was said about types of nuclear reactors or when not even accepted practice to speak of their presence. It was comfortable then. It did not matter that there was a letter box. It seemed that Cherepin is too young to be a director with two nuclear reactors under his authority. But we began to talk and any perception of his youth turned out to be just a fleeting impression.

Yu.S. Cherepin: Three main directions in our work may be identified. First, there is the safety of nuclear power. Second, there is nuclear physics technological research. Third, we have not forgotten the national economy, which uses the products of our labor. I say without false modesty that we are, to a certain degree, overtaking time in our work. There are problem areas in which we have proceeded farther than the United States.

Question by S. Kuts: Given the overall situation in the country and in your sector?...

Yu.S. Cherepin: You are speaking of the decision to eliminate all reactors in the country because of strong community pressure? Yes, there is that sort of mood-....But we believe that the expedition should play a leading role in the sector's survival. The workplace permits 20,000 square kilometers! And so it has turned out that a center of union scale has been formed here. We are posing the question of expanding our base and financing our labor.

Question: I would like to hear about the practical application of its results....

Cherepin: Take the first direction—the safety of nuclear power. We are simulating possible grave accidents with the structural elements of a nuclear reactor. We are focusing on their consequences and studying how much damage the structure sustains.

Question: Could you speak albeit briefly about the Chernobyl tragedy even though it has been mentioned often in the press?

Cherepin: We have long understood that this problem needs to be studied—even tens of years ago. Even before the accident we had already "calculated" it, and we turned to the chief designers of power reactors. But we did not reach any understanding with the creators of the Chernobyl reactor. They simply rejected our services.

Question: And you could have prevented the trouble?

Cherepin: Of course. By investigating we could have stumbled onto something and prevented it....They agreed that we could work on another type of reactor but not on the one that had the trouble. They supported us and began to finance us....

Question: What lay at the basis of the unfortunate reactor's design?

Cherepin: It had a cylindrical core made of graphite bricks. The core was 7.5 m in diameter and 12 m high. The bricks contained small holes to flush the channels with gas. There was flushing (cooling) with water. The designers of the water flushing of the reactor channels agreed to work with us immediately. The others refused.

How do we work? We specify an accident situation and follow it to see what happens. We give the designers figures, and they begin to think about the design in the sense of improving it. Such is the practical outcome of our labor. For example, we investigated the possibility that reactor fuel (uranium) would get into the water (in a reactor with water cooling) and that it would react with the water. Only we have obtained such experimental data. The results are invaluable to designers. They have their own computations, but ours explained the situation much more precisely.

Question: In other words, you work on "plans" of accidents. In essence, you look for safety coordinates in the use of nuclear reactors, find them, and pass them on to those using nuclear technology.

Cherepin: I will explain more precisely. In safety coordinates we assign the parameters of consequences rather than causes. We determine what will happen, let us say, if a reactor explodes. Another big problem that is being evaluated on an international plane is the study of the behavior of the components of decomposition during an accident, that is to say, the reaction of uranium with water and the formation of vapor, gas, and fission products....We determine how possible it is to then restore the unit and operate it further (naturally, safely).

Question: You do not create nuclear weaponry?

Cherepin: No. We do not work on weaponry.

Question: But then why are you here on the proving grounds?

Cherepin: Kurchatov made nuclear weaponry here between 1945 and 1956. The first bomb was tested here. Then he got the idea of developing nuclear technology as well. This is where his group of scientists worked and where his construction base was....Plutonium was created in reactors, institutes were created throughout the

country, scientific efforts were involved, the design technology was set up. A big system of efforts was at work. Kurchatov worked on preparing and testing the first atomic bomb. A reactor was created at the proving ground in parallel. It was started up in 1961. And we began with it. At the time we were carried away with gas-cooled reactors. It was a step toward creating nuclear engines for spacecraft.

Question: Where are the results of your work in nuclear power safety being realized?

Cherepin: Our approaches have been realized almost everywhere throughout the country where there are reactors. We are working on an entire safety program. The attention is always on whatever problems have not been worked out. But we started in this country first....

Question: You spoke of the national economy that uses the products of your labor....

Cherepin: This does not just mean the Kazakhstan region. Let us say that we have designed a system to monitor the status of grain in a grain elevators. We have received a number of orders from enterprises for our invention, which looks rather simple and which is also rather simple to install and operate. Previously, a grain sample was taken by using a probe, and its content was determined. The result was not that precise. We proposed three rods. Each of them contained heat sensors (connected to a display terminal) at three levels. The monitoring of the grain's status is constant.

Question: A convenient thing....

Cherepin: But not all managers accept it. A whole shift of workers crowd around the probe. But they do not need our instrument.

What are we to do? Take shuttles for sewing machines. There is a great shortage! They cannot be made by anyone anywhere. We make them. And this is far from all that we know how to do....In general, we provide tens of thousands of rubles worth of services "for the home and for the family."

Question: The proving ground has not yet been converted, but you are involved in it....

Cherepin: The meaning of our actions lies not just in living under market conditions; it lies in the regional economic ties that we need. Just like any sector. Yet another of our conversion developments is the black coal briquette. (Yuriy Semenovich shows a black tablet.) We began making it at the order of the Kansko-Achinsk Basin. What is the advantage of the briquette? It produces 2.5-fold more calories than conventional coal because the superfluous components are removed when the briquette is produced. It is more convenient to transport and can be shipped in boxes. We have developed a technology without binding components. The technologies existing before of course added something to the briquette. We eliminated the binding elements by selecting the conditions under which it is produced: temperature, pressure, medium. Not using binders is advantageous not only from the standpoint of calories produced but also from an ecological standpoint. This year we are developing the engineering design of a line to produce tens of tons of briquettes each year. We are now working on an experimental design and unit. This unit will stand on a bed and "bake" the briquettes. After final approval of the pilot unit, the plant will manufacture series-produced equipment. The country's coal recoverers will be able to trade this fuel more successfully than what they are now recovering. Coal in natural form is transported moist in cars (they carry water). That is why it is cheap on the world market. Moisture results in problems related to its keeping qualities.

Or take another of our developments—the dosimeter. (Yuriy Semenovich takes a small white box that is a little smaller than a journalist's Dictaphone from the table). We could produce it successfully, but things are going badly with its completing components.

Question: It seems that, without soldiers, you have a rather objective idea of the radiation situation on the proving ground and around it?

Cherepin: Yes. We can take measurements with respect to all parameters. It is impossible to frighten us.

Question: For the simple citizen, the proving ground seems to be something of a scarecrow....

Cherepin: It has always been that way. There is nothing you can do. All these years the people have been poorly informed. And now when competent commissions announce that the proving ground is safe, the announcement is not believed. The time of ground and air explosions on the proving ground was a grave time. That was when the public's current attitude toward the Semipalatinsk phenomenon was formed. Changing it is more difficult than forming it anew.

Question: What are you doing for the city of Kurchatov?

Cherepin: We are truly doing a great deal for our own city. We have a sponsored school where our workers study with the children. They have been furnished with the oblast's first computer class. Thirty percent of the republic olympics in physical and mathematical disciplines consists of pupils from the Kurchatov school. Circles and sections work in the school under our direction...We have good ties with Tomsk Polytechnic Institute, where our school's pupils go. We have even concluded an agreement with the institute that gives our enterprise the right to recommend graduates of the Kurchatov school to the institute, i.e., to given them a direction. Last year 14 persons entered different departments at the institute at our recommendation. We often go there on out-of-town assignments. By agreement, we accept the polytechnic institute's students to do practical work and for prediploma work as well. They prepare their diploma works at our base and defend them in front of our commission.

Question: And what about economic problems?

Cherepin: There are enough of them. We have extensive residential resources that naturally need upkeep. The gardening season is beginning, and we are providing transportation for the summer residents. We are taking it upon ourselves to take passengers to the airport.

We are busy with construction. Last year we turned over a kindergarten with a pond. It was the city's first. We are building residences. Walk down the street. In the past 3 years, we were the only ones building. As soon as the mood turned against the proving ground in the past few years, all organizations made a sharp turnaround in their social problems related to Kurchatov after having lost their confidence. And they started allocating a great deal less money. We have had to do things ourselves....In 1989 alone we spent 7 million rubles. Last year we spent 4 million. This year the total volume of major construction proceeding through us will be on the order of tens of millions. We are now building a health center and pond....There is a unique athletic center that more than 300 persons can use simultaneously.

Last year, along with the kindergarten, we built a clubhouse for children. It is a large building....The city's social and cultural life is developing primarily thanks to us. We understand that in view of the situation he is now in (not even a semistructure but only some part of one and the absence of real authority), the urban Soviet cannot give us any perceptible help. All we ask for is support. We will get help from the oblast committee of Kazakhstan's Communist Party and personal help from its first secretary Keshrim Boztayevich Boztayev, as well as from the executive committee of the oblast soviet of workers' deputies [oblispolkom].

We have developed good relations (working ties) with the Kazakhstan SSR Academy of Sciences and especially with the Geological Sciences Institute. We have only started working "in harmony" with the republic in the past few years. Before that, the circle of organizations with which "it was possible" seemed strictly demarcated. It has since expanded significantly. The document regarding conversion operations on the proving ground that the Minatomenergoprom and union academy of sciences jointly adopted last year helped make this possible. Kazakhstan's minister of power generation also signed the document.

Question: Are you carrying it out?

Cherepin: Of course. You see (Yuriy Semenovich shows the document), who (i.e., which institutes of the republics academy of sciences) will participate in what work has been decided, and the financing has been determined. True, not everything has been successful, but something is being done. It is our initiative. The country's Nuclear Physics Institute has kept it healthy.

Question: What do you mean by "something"?

Cherepin: Specifically, the construction of a nuclear power plant on the proving ground. There was a conversation about it here, in the oblast, and then in Alma-Ata. At first our idea was not too welcome. But we convinced them and made them understand by way of the example of the republic's power system. If our idea is brought to life, the amount of electric power in the republic will triple. The Kazakhstan Academy of Sciences supported us. Should we count on thermal power plants (especially since there is enough coal and seams may be uncovered in the Balkhash region)? The academicians warned that all of the soot from thermal electric power plants will rain on the mountains. Intensive thawing of the glaciers, and then....The consequences cannot be predicted.

We communicated with the country's leading academician-power engineers and agreed to meet with then on the given problem in Alma-Ata in June. They agreed that our nuclear power generation program will receive an alternative evaluation....

Question: Moreover, it is already taking place. Right after publishing an interview with Yevgeniy Vladimirovich Chaykovskiy, chairman of the city executive committee of the oblast soviet of workers' deputies [ispolkom] of the city of Kurchatov, in which he stated the possibility of construction of a nuclear power plant on the proving ground, the editorial staff received letters expressing no small amount of skepticism and direct objections. Given the country's present mood toward nuclear power plants....

Cherepin: We are professionals and we proceed from dispassionate analysis of the possibilities of producing nuclear power. Our calculations have led to one conclusion: There is still no more progressive method of power generation in the country (or in the world). Of course, Chernobyl was a powerful blow to the problem. But Chernobyl was an extraordinary case in nuclear power generation. It was hard to believe....What bungling! It was like riding in a car and consciously disconnecting the brake. What is to be said if operating personnel eliminate six layers of reactor protection one after the other. The emergency protection system was disconnected and blocked. It is improbable!

Question: Evidently what is needed is protection (and it is undoubtedly needed!) not so much from the power generation technology itself but more from a fool...

Cherepin: As you have understood from our conversation, we are working on this. We are interested in the very process of the development of an accident.

What is nuclear power generation? It cannot be discussed unless its essence is understood. Our society still has more emotions than factual material in this regard. Careful analytical work confirm that living under the pipeline of a conventional coal-fired thermal power plant is thousands to tens of thousands times more dangerous than living under the pipeline of a nuclear power plant. But no one anywhere has explained this intelligibly.

Question: It has simply not been undertaken.

Cherepin: It must be undertaken. There are no bounds to knowledge in matters of the safety of generating nuclear power. Mankind must find the means and abilities to improve itself in these matters. Ultimately, this improvement will increase human safety.

Consideration must be given to the fact that by solving the problems facing nuclear power generation, the sector's specialists will also make discoveries that will provide great savings to society in related sectors. That is to say, knowledge and experience will be transferred from one sector to another.

Unfortunately, there are few who are currently thinking about pure science. From the academician to the ordinary engineer, everyone is occupied by one thought—to survive. The purely physical has supplanted the scientific quest. I do not know any people who can concern themselves with both at the same time.

Question: The scientific world is a world of ascetics....

Cherepin: It is better for large unique scientific centers to be financed by the country's budget than for scientists to acquire the resources for their scientific quests themselves based on economic accountability by rolling up their sleeves.

Question: That is interesting. How old is your collective?

Cherepin: We are aging quietly....We have been forced to cut down on young specialists. Before, we would get 50 to 60 young specialists each year. I love the young. You can put any problem before them—even the most improbable! And the results are very good. You do not give such problems to the more mature specialist; he will show no small degree of skepticism, and nothing will come of it. The mature specialist is inclined to work on what he knows how to do. It is hard for a person who has worked for us for 15 or 20 years to turn to some new problem. New directions are the destiny of youth.

Question: Do your retirees stay in Kurchatov?

Cherepin: They stay. It naturally depends on the material base. Sometimes we have a program to construct residences for such specialists. Where is a person to go after spending his entire life here and when his children have grown and begun to work alongside their parents? Although, we still build residences for them in Pavlodar and Semipalatinsk (the republic region). In a word, things are going poorly in Semipalatinsk. The percentage of the plan that is being met is low, even though we have invested 1.5 million rubles in residential construction in a year and a half. We are also building in Kubani and Ural. Cooperatives have been organized in this respect in the Krasnodar Kray and in Pavlodar. We have persons who wish to build homes for themselves here and in Kurchatov, and I support them. There is space to build one-story homes. We are constantly being threatened: Do not build any homes in the area of the proving ground. The land is a military department. Tomorrow some doctrine will suddenly be announced. Do not build a home, do not plant trees. But people are people....And so our city has grown, developed, and become populated.

Included among the notes in my notebook from this conversation is a very simple diagram: an ellipsis turned upside down and bounded by the right angle of coordinate axes. The diagram may be entitled "The Extent of Danger When Generating Power." A coal-fired station occupies the top point of the coordinates. Less dangerous is a thermal electric power plant that uses mazout and gas to produce electric power. Nuclear power is the least dangerous.

Befriend a monster? Build relations with him such that he only radiates kindness? For this, mankind must rise to a new intellectual order. This is what Yuriy Semenovich and his colleagues are doing by continuing one of the lines of the fate of our fatherland in the palm of the Semipalatinsk steppe. This line has already been designated in terms of units to treat oncology patients and rocket units with nuclear warheads, the Chernobyl tragedy, the risk-free voyages of nuclear icebreakers in icy latitudes, and the unending power of nuclear power plants...

What course will the line of fate take tomorrow?

Determining Underground Explosion Energy

917F0323A Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 317 Mar-Apr 91 pp 67-70

[Article by I.O. Kitov, S.K. Daragan, O.P. Kuznetsov, Geophysics Institute imeni S.Yu. Schmidt at the USSR Academy of Sciences, Moscow; submitted by Academician M.A. Sadovskiy]

UDC 550.094

[Abstract] Methods of determining the total energy of a seismic source which is generally represented as a sum of seismic energy, i.e., the energy of elastic waves propagating from the source and the energy remaining within the source in a certain form are outlined. Specific aspects of this problem in the case of an underground explosion whose energy is expended primarily for fracturing the surrounding rock and is eventually transformed into thermal energy are investigated. It is shown that by determining the energy expended for fracturing the rock we basically determine the explosion energy; elastic wave emission during this process serves as the physical basis for measuring this energy. Two wave emission mechanisms - one standard, related to the expansion of detonation products described by the function of displacement on an elastic sphere and another related to the emission of elastic waves due to the fracturing of medium within the source under the effect of the explosion wave - are investigated. The second mechanism is similar to earthquakes in nature. These emission mechanisms are attributed to blocks of varying size in the framework of the block model of a real geophysical medium. The task of recording explosion-generated

seismic oscillation in the epicenter zone and its specific features are considered and the results of experimental studies carried out during explosions of various charges in different types of rock are summarized. An analysis of experimental data made it possible to conclude that the value of the similitude criteria (dimensionless numbers) for all explosions are virtually constant regardless of the explosion magnitude and rock type and that the accuracy of determining the total explosion energy by separating low- and high-frequency seismic signal components is roughly equal to 10% according to the value variation. It is shown that it is necessary further to refine the value of the medium's similitude criterion in order to determine the total explosion energy with greater accuracy. References 4; figures 1; tables 1.

On One Possible Outcome of Underground Nuclear Tests

917F0322A Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 316 No 6, Feb 91 pp 1367-1371

[Article by V.I. Ilichev, G.P. Cherepanov, Pacific Oceanological Institute at the Far Eastern Branch of the USSR Academy of Sciences, Vladivostok]

UDC 550.3+539.1

[Abstract] Possible catastrophic consequences of man's intrusion into the ecological harmony of nature, especially by means of using the energy of nuclear explosions, are examined. It is stressed that even isolated underground nuclear tests can be dangerous since the earth's solid crust is an elastic and brittle medium. A method of estimating horizontal stresses in the lithosphere is proposed on the basis of fracture mechanics concepts; then the change in the earthquake epicenter's elastic energy is analyzed. It is shown that in the case of fault-like scarp areas, elastic energy is pumped into the quake epicenter rather than being released. Finally, the seismic energy of a superquake which, in principle, may be triggered by a single underground nuclear test is estimated. It is shown that the superearthquake hypothesis is consistent with fracture mechanics and M.A. Sadovskiy's space-time concepts of the earthquake magnitude and frequency and does not contradict any geological, geophysical, or historical data since the mean superquake spacing interval is 10,000 years. A superquake is roughly equivalent to 10^8 megaton bombs, i.e., one bomb per 1 km^2 of land. References 11: 9 Russian, 2 Western; figures 1.

Determining Thermodynamically Optimal Nuclear Power Generating Unit Indicators and Nuclear Fuel Exergy

917F0328A Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 5, May 91 pp 86-90

[Article by G.P. Verkhivker, Odessa Polytechnic Institute]

UDC 621.1.018.4:536.73

[Abstract] Characteristic features of a nuclear power generating unit (YaEU), i.e., its simultaneous generation of energy (thermal, electric, and mechanical) and nonenergy (desalinated water, combustible gases, sponge iron, and other substances resulting from chemical reactions which consume nuclear reactor heat as well as secondary nuclear fuel and products of nuclear fission in the reactor itself) products are outlined. Approaches to evaluating the nuclear power generating unit efficiency, i.e., the ratio of the generated electric or heat power to the heat released by the nuclear reactor, and their shortcomings are discussed and an expression for the generating unit system efficiency (KPD) is derived. A thermodynamic indicator is proposed for making objective estimates of power and product generating units of nuclear power plants; it takes into account both the operation of the units themselves and their effect on adjacent and cooperating plants. A technique is developed for estimating the nuclear component of the nuclear fuel and its fission product energy liberation. References 6.

Main Results of Vibration Tests Undergone by "Turboatom" K-1000-60/1500-2 Turbines

917F0237A Moscow TEPLOENERGETIKA in Russian No 2, Feb 91 pp 6-9

[Article by Yu.I. Monogarov, candidate of technical sciences, A.I. Smirnyy, engineer, N.V. Kabanova, engineer, I.M. Kvaktun, engineer, and N.V. Rogozina, engineer, Scientific-Industrial Association Central Boiler and Turbine Institute and Industrial Association "Turboatom"]

UDC 621.165.620.178.53

[Abstract] Vibration tests were performed on a model K-1000-60/1500-2 turbine, which had been designed and built at the Kharkov Turbine Plant of the Industrial Association "Turboatom" for nuclear power plants with VVER-1000 MW water-cooled water-moderated power reactors. This turbine consists of three low-pressure stages and one high-pressure stage, with condensers located at a lower level, unlike the preceding K-1000-60/1500-1 model turbine with an intermediate-pressure fifth stage and condensers placed laterally. During startup and incremental loading up were monitored the variations of the lubricant film thickness in the journal bearings under various thermal conditions and the variations of the journal position relative to the bushings under various loads including no load, amplitude-frequency and phase-frequency characteristics of bearing and journal vibrations being recorded at the same time. Measurements during startup have revealed the resonance bands of vertical and lateral vibrations of the "shaft - lubricant films - bearings" system, those of vertical vibrations being 1150 rpm and 1270-1300 rpm, those of lateral vibrations being 800-900 rpm, 1100-1200 rpm, and 1350 rpm. Axial vibrations were also measured during startup and in the running mode. Measurements

were made with a BIP-5 vibration meter and a Bruel & Kjoer "Vibrometer", also with Schenk "Vibroport" and "Vibrometer-10" instruments. An analysis of the results indicates that the principal cause of excessive vibrations is thermoelastic deflection of the runner in the high-pressure stage by water drops falling on it and that, moisture needs to be kept out of end seals if normal vibration levels are to be maintained when the turbine runs under light or no load. This in turn requires maintaining a steady temperature of the steam in those seals and also ensuring a temperature difference between the turbine foundation and the turbine service platform. Figures 3; references 8.

Performance Indicators of Automated Systems for Comprehensive Technical Diagnostic Testing of Power Unit Equipment

917F0237B Moscow TEPLOENERGETIKA in Russian No 2, Feb 91 pp 25-28

[Article by A.Sh. Leyzerovich, doctor of technical sciences, A.A. Gordinskiy, candidate of technical sciences, and A.M. Zhuravel, engineer]

UDC 621.311.22.002.51.62-5

[Abstract] Design of automated systems for comprehensive technical diagnostic testing (ASCTD) is methodically evaluated for their application to power plant equipment, typically boilers and turbines, designing such a system being not only a quantitative problem but also a problem of qualitative optimization or at least of rational scope selection. The design of such a system must, accordingly, take into account its interaction with other components of the automated system for control of technological processes (ASCTP) as well as the programmability of testing procedures. From this standpoint, then, are defined several performance indicators which characterize the effectiveness of automated diagnostic testing systems and should serve as design criteria. The four principal indicators are completeness, complexity, thoroughness, and reliability of testing. The consequences of inadequacy of any of these indicators are discussed, particular importance being ascribed to reliability which, if not adequate, may result in "missed fault" or "false alarm" errors. A fifth not much less indicator is nontriviality of the test results, determined essentially by their information content meaningful to the user. Reproducibility of readings is a sixth indicator, especially important when it comes to transient and high-frequency modes of power equipment operation. All performance indicators are subject to cost analysis, taking into account permissible tolerances. Inasmuch as new test methods and instruments may very well be developed or old ones improved within a short period an ASCTD has been in service, its design must be flexible and allow for modifications following revised performance evaluations. This applies especially to an ASCTD designed for operation in existing power units with already fixed and limiting constraints. References 14.

Selective Uranium Ore Bed Mining by Bucket Wheel Excavators

917F0348A Moscow GORNYY ZHURNAL in Russian No 5, May 91 pp 47-51

[Article by Ye.A. Kotenko, All-Union Research and Design Institute of Industrial Technology]

UDC 622.349.5:622.063.44:621.879.48

[Abstract] The method of separate mining of thin sloping uranium ore seams by high-output bucket wheel excavators used for the first time is quarry No. 1 of the Caspian Integrated Mining and Metallurgical Works is discussed and an attempt is made to develop efficient processes, optimal excavation parameters, and engineering principles for stored-program automatic bucket wheel excavator control on the basis of known theoretical and experimental studies in order to optimize the above method using ERG-400/1000 and ER-1250 series excavators. An analysis of the resulting selective mining method reveals that in working ore seams thinner than 2.23-2.26 m, bucket wheel excavators are more efficient in the side stope than in the frontal one while the frontal method is more efficient when working beds thicker than 2.4 m. ERG-400/1000 and ER-1250 excavators have a 350-380 m^3/h ore output. Thus, the newly developed methods and optimal excavation technique for sloping sandy clay uranium ore seams combined with selective mining of complex structured benches by ERG-400/1000 and ER-1250 bucket wheel excavators are labor-saving and help to ensure the maximum productivity with very low energy outlays, losses, and impoverishment of a valuable mineral. Figures 3.

Abstracts From 'Bulletin of the BSSR Academy of Sciences. Series Physical and Energy Sciences'

917F0288A Minsk IZVESTIYA AKADEMII NAUK BSSR SERIYA FIZIKO-ENERGETICHESKIKH NAUK in Russian No 1, 1991 pp 124-128

[Abstracts appearing in "Bulletin of the BSSR Academy of Sciences. Series Physical and Energy Sciences," No 1, 1991]

[Text]

UDC 621.311.25:621.039.5

The Problem of Creating an AES Safety System Based on Passive Operating Principles (Part 1). L.I. Kolykhan and L.N. Falkovskiy, pp 5-12

The authors demonstrate that a high safety level may be achieved by creating systems based on passive operating principles. This is shown by an analysis of current criteria and requirements regarding the stability of AES during serious accidents. Energy release sources for conditions of a serious accident are considered. Table 1, figure 1, references 16.

UDC 658.012.011.56:621.039

Development of AES Operating Personnel Support Systems. G.V. Kostyukevich and S.N. Rymarchik, pp 13-18

The authors propose an expert system to support AES operators. Installing the system at an AES will make it possible to increase operating reliability and perform early real-time diagnosis of power unit equipment and operating modes, as well as forecasting of the development of routine situations. Figures 2, references 18.

UDC 621.039.51

Transfer of Radioactive Fission Products in Arbitrarily Shaped Channels With Consideration of Their Velocity Profile. I.A. Savushkin and Ye.I. Ravkova, pp 19-26

This article describes the integral Laplace transform method and Bubnov-Galerkin method with respect to investigation of the diffusion of fission fragments in channels with an arbitrary cross section. Analytical expressions are derived for the concentration of fission fragments in the channel's thickness and on its walls. A formula is found for the coefficient of precipitation onto the walls of a cylindrical channel for the case of a parabolic velocity profile, and graphs of selected dependences are presented. Figures 2 and references 3.

UDC 620.169.2:621.039.56

Estimating the Minimal Acceleration Coefficient During Boosted Tests of a Reactor Control and Protection System's Actuator. O.G. Kamyshnikov, N.O. Kurbatskiy, V.I. Morozkin, and N.P. Rubtsov, pp 26-28

This work is devoted to the problems of creating and developing the elements of a reactor control and protection system. The authors propose a method for estimating the minimal acceleration factor for boosted life tests during experimental development and confirmation of the life characteristics of a reactor control and protection system's actuators. The method is based on the equality of the dissipated mechanical energy in the actuator's elements during boosted and rated modes. References 6.

UDC 539.172.4+539.172.6+621.039.53

Nucleon Shift Cross Sections To Compute a Damaging Dose From 50 to 500 MeV. A.Yu. Konobeyev, Yu.A. Korovin, and V.N. Sosnin, pp 29-33

This article presents computations of the neutron and proton shift cross sections in the energy range from 50 to 500 MeV by using the DIDACS program set, which was developed by the authors. Nucleon shift cross section values are obtained for titanium, vanadium, chromium, iron, nickel, zirconium, and molybdenum. Nucleon shift cross sections for inelastic interactions are computed based on the cascade-vaporization model. Neutron shift cross sections for elastic scattering were calculated based on an optical model at energies up to 150 MeV, and elastic proton shift cross sections were computed based on the Lindhard-Nilsen-Scharff theory. The nucleon shift cross section values obtained are presented in the form of simple energy dependences of the primary particles and mass number of the target nucleus.

The computed nucleon shift cross sections may be used to estimate the rate of radiation damage of materials located in the structures of accelerators and power plants and subjected to irradiation by high-energy nucleons. Table 1, figure 1, references 13.

UDC 621.439

Development of an Analog Model of a Closed-Cycle Gas Turbogenerator To Investigate the Dynamics of Control on a Semi-Full-Scale Stand. G.I. Nitey and G.Yu. Koitsevich, pp 34-40

This article presents a mathematical model intended for analog computer modeling of the dynamics of a closed-cycle gas turbogenerator as a revolution frequency control object. The model developed is used in a semi-full-scale stand to connect the simulator of the object's dynamics with an actual rotation frequency regulator. Figures 3, references 3.

UDC 621.643.001.5

The Stress-Strained State of a Straight Underground Pipeline Subjected to the Effect of a Longitudinal Seismic Wave. I.S. Kulikov and L.N. Shegidevich, pp 40-44

A rod model and the finite-difference method are used to solve the problem of the stress-strained state of an underground pipeline with concentrated masses during propagation of a longitudinal seismic wave. The TPUB5 program has been developed to make practical computations. Results of computations of a straight underground pipeline with concentrated masses are presented. Figures 2, references 7.

UDC 660.14.018.293:621.039.531

Integrated Experimental Study of the Properties of 08Cr19Ni12Ti Steel in Connection With Long-Term Operation of an AES Reactor Coolant Pipe. L.A. Sosnovskiy, L.A. Khamaza, A.F. Getman, N.K. Babich, and A.V. Bogdanovich, pp 45-52

The authors experimentally establish selected laws governing the effect of long-term operation under conditions of the primary loop of an AES pipeline on the change in the mechanical properties of its material (i.e., fatigue life, endurance limit, cyclic crack resistance, and hardness). Tables 3, figures 3, references 9.

UDC 548.0.539

Free-Electron Lasers Based on Parametric (Quasi-Cherenkov) Radiation. V.G. Baryshevskiy, K.G. Batrakov, and I.Ya. Dubovskaya, pp 53-60

This article presents research on a quasi-Cherenkov free-electron laser. Lasing threshold equations are derived. The threshold dependences for generation of radiation in the x-ray and optical ranges are investigated, and the particle acceleration mode is also given. References 11.

UDC 548.0.539

Angular Distribution of an Oscillator's Diffraction Radiation. A.O. Grubich and O.M. Lugovskaya, pp 61-67

This work analyzes the dispersion curves of an oscillator's diffraction radiation for the side radiation maximum. An explicit expression is derived for the angular distribution of the radiation received at all ultrarelativistic particle energies. Figures 2, references 13.

UDC 536.633.1/2:537.29

Determining the Drift of the Parameters of a Phase Transition of the First Type of Dielectric Media in a Variable Electrical Field. A.S. Galperin and G.G. Kuleshov, pp 68-73

This article examines a general problem of the thermodynamic behavior of a dielectric in an external variable electrical field. The complex amplitude method is used to derive expressions for the operation of polarization and specific heat capacity of a nonmagnetic dielectric medium as a function of the field's amplitude and frequency and the thermodynamic state parameters. The amount of drift of the equilibrium temperature of an isobaric phase transition of the first type of a dielectric in a variable external electrical field is estimated in a first approximation of a thermodynamic theory of disturbances in which the very same medium but in the absence of an external field is taken as the undisturbed system. It is shown that the change in the operation of polarization occurring throughout the depth of a medium in a variable field is nonmonotonic in nature. This may result in a local reduction in the thermodynamic "strength" of a liquid phase that is in equilibrium with the vapor phase, i.e., to a localized phase increment initiated by an external field. Figures 2, references 11.

UDC 681.324:536.3:535.21

Using a Multiprocessor System To Process Infrared Images. V.L. Dragun, M.N. Dolgikh, and S.A. Filatov, pp 73-77

The authors describe the use of a multiprocessor system to process infrared images in a computer infrared thermography system using a type MT-70 fast peripheral processor with a two-port working memory to store user microprograms. Figures 2, references 7.

UDC 621.039

Estimating the Magnitude of Local Shear Stresses Arising When a Bubble Makes Contact With a Wall in a Two-Component Ascending Stream. Yu.P. Arestenko, N.I. Vasilyev, V.V. Guguchkin, and A.S. Trofimov, pp 77-82

The authors investigate the motion of gas bubbles in a two-component ascending stream close to a wall. A research methodology and experimental device are described. Photographs of an air bubble close to a channel wall are presented, and the process of the bubble's interaction with the wall is described.

The magnitude of the normal and shear local instantaneous stresses arising as the bubble interacts with the channel wall is estimated. Figures 3, references 3.

UDC 536.25

Interaction of Thermal Gravitation and Thermocapillary Convections in a Partially Filled Vessel in a Variable Acceleration Vector Field. A.V. Korolkov, pp 82-87

A computer experiment is used to study the interaction of thermal gravitation and thermocapillary convections in the field of an acceleration vector rotating at a constant angular velocity. The model problem is formulated based on the Konvektsiya-1 experiment that was conducted on the Salyut-6 orbital scientific station. It is shown that as the Marangoni number increases, thermocapillary convection may intensify the effect of a convective flow's intensity as compared with convection in a constant vector acceleration field. Table 1, figures 2, references 6.

UDC 536.24:532.54

Hydrodynamics and Heat Transfer of a Bundle of Fibers Moving in the Plane Channel of a Heating Furnace. V.I. Yeliseyev and Yu.P. Sovit, pp 87-94

The authors propose a filtration model of convective heat transfer of a bundle of fibers moving in a plane channel. Analytical solutions of Ozeyen-linearized equations are derived, the dependences of the lengths of the dynamic and initial sections in the channel on the key parameters are determined, and estimates of the lengths of the working sections of furnaces for heat-treating fibers are found. Numerical computations of the heating of fibers in a beam are performed for the case of an isothermal channel wall or for the case where a constant heat flux is specified in it. The computation results presented show the effect of the placement density and the position of a fiber in the beam on the intensity of heat transfer. Tables 2, figures 2, references 10.

UDC 621.311.25

Method of Determining the Thermal Characteristics of Ribbed and Plated Surfaces. S.V. Chernousov, pp 95-98

The authors propose a method of determining the thermal characteristics of ribbed and plated surfaces based on the aerodynamic similarity of the processes occurring along both sides of the heat exchanger. The conditions required for implementation of the method are described. Figure 1, references 5.

UDC 536.21

Thermophysical Properties of Mineral Ores From the Starobinsk Potassium Salt Bed. S.S. Andreyko, V.S. Dubrovskiy, L.Ye. Yevseyeva, L.V. Bylina, and S.A. Tanayeva, pp 98-100

This article presents the results of an experimental investigation of the thermophysical characteristics (heat conduction coefficients and specific heat capacity) of mineral ore specimens from the Starobinsk potassium salt deposit in the temperature range from 0 to 50°C. Tables 2, references 2.

UDC 539.3:621.92

Rheodynamics of Magnetic-Abrasive Materials in the Gap Between Parallel Planes. A.Yu. Tarasova, N.S. Khomich, and B.M. Khusid, pp 100-107

This article considers the problem of the packing of a magnetic-abrasive material between two disks. Graphically illustrated numerical computations are performed based on analytically derived dependences of the change in dimensions of the magnetic-abrasive material as a result of its packing on time, velocity of the upper disk, and the amounts of slip and shear stress. Figures 3, references 2.

UDC 532.62

Interaction of an Evaporated Liquid Film With a Cocurrent Flow and Its Effect on Departure From Nucleate Boiling. E.L. Kitanin, pp 107-115

The authors analyze the results of an experimental study of the thickness of a liquid film moving along a heated channel wall in a concurrent flow of gas or vapor produced in various gas-and-liquid flows. It is established that in a number of cases of near departure from nucleate boiling associated with the film's disappearance, the latter becomes thinner as the heat flux increases. The explanation for this effect is connected to the effect of the blast (of the vapor or vapor-and-gas flow from the film surface) on the friction stress on the film's surface. An increase in thickness may occur even in the case where, besides vaporization, the flow rate in the film is reduce by the separation of drops. Because the thickening of the film is unequivocally linked to a reduction in heat release, when q = const this results in its superheating, the initiation of boiling, the formation of dry spots, and the transition to a streamlet flow mode. Thus, in the case of a specified ratio of liquid and gas flow rates and given significant heat inflows, a departure from nucleate boiling may be associated not with complete vaporization of the film but rather with its breakdown owing to the onset of boiling. Tables 2, figures 3, references 21.

UDC 536.212:621.5

Precision of One-Dimensional Approximations During Local Heating of Plane Elements. I.Ye. Zino and A.B. Sulin, pp 115-118

The authors propose computational formulas and graphs that make it possible to estimate the real magnitude of heat transfer through a plane wall subjected to local heating as well as to estimate the precision of generally accepted one-dimensional approximation methods as compared with existing two-dimensional models. Figures 3, references 7.

UDC 532.13

Viscosity of a Nitrogen Dioxide-Nitrogen Oxide Solution at Nitrogen Oxide Concentrations up to 0.3. O.V. Belyayeva, V.I. Kazazyan, V.I. Struchkov, and V.N. Shupayev, pp 118-123

The authors present experimental data on the viscosity of the liquid phase of a nitrogen dioxide-nitrogen oxide solution in the case of nitrogen oxide concentrations of 0.19, 0.23, and 0.31 in temperatures ranging from 300 to 350 K and under pressures of 4 to 15 MPa. The investigation was conducted by the decreasing load method, with the error of the experimental quantities amounting to 3-4%. The solution's viscosity was found to be nonlinearly dependent on the nitrogen oxide concentration. Together with data obtained earlier at nitrogen oxide concentrations of 0, 0.555, 0.09, 0.15, and 0.18, the test data were generalized by using a semiempirical equation permitting extrapolation in the range of reduced temperatures and elevated pressures. Tables of the experimental and smoothed values of the solution's viscosity are presented. Tables 4, references 12.

Abnormal and Emergency Operation Detection, Recording, and Display in Thermal Power Plant Generating Units' Automatic Process Control Systems

917F0329A Minsk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ENERGETIKA in Russian No 5, May 91 pp 99-103

[Article by V.Kh. Sopyanik, T.A. Zhernosekova, A.M. Mazurov, G.T. Mindiyarov, Western Branch of the Thermal Engineering Research Institute]

UDC 621.311.22:658.5.011.56

[Abstract] One of the most important on-line information tasks of power generating units' automatic process control systems (ASU TP) - to monitor process indicators, record abnormal and emergency operating conditions as well as provide the information to generating unit staff and compare current values of process parameters and their increments to standard and alarm settings - is addressed. It is shown that this ASU TP task makes it possible not only to maintain the process at a proper level but also identify abnormal and predict emergency operation as well as diagnose and forecast the status of various types of equipment. Monitoring and control algorithm developed for ASU TP are described; analog parameters during an information scanning cycle are compared to standard and upper and lower bound alarm settings, and when the parameter exceeds permissible upper and lower bounds, this fact is displayed on a color monitor by highlighting the process unit or its number in the generalized power generating unit diagram. The variable rate of change (SKI) is monitored by comparing the increment during the scanning cycle to a preset value of the rate of change. The algorithm enables generating unit operators to identify, record, and report the onset, development, and elimination of the emergency situation as well as simulate the emergency, establish its cause, and take steps aimed at identifying and preventing future emergencies. The algorithm has been implemented in a 300 MW generating unit of the Azeri State Power Plant and Yuzhnaya Thermoelectric Plant of the Leningrad Regional Power Administration. References 2; figures 2.

Mobile Drilling Rigs

917F0350A Moscow RAZVEDKA I OKHRANA NEDR in Russian No 3, Mar 91 pp 15-16

[Article by Yu.V. Agureyev, V.G. Lvov, N.S. Yakimova, Geologorazvedka Production Directorate]

UDC 622.242.2.055

[Abstract] Prototypes of the new UKB-1200/2000P and UKB-500/800P class 5 and 7 wheeled mobile drilling rigs which passed official acceptance tests in Kazakhstan and Ukraine in 1988 and were recommended for commercial production are described. Operating manuals for the rigs intended for various geographic regions were developed by the Zelenogorsk expedition. The rigs are intended for drilling exploratory and prospecting wells under various terrain and climatic conditions to a depth which depends on the specific equipment. Rig specifications are summarized in a table. Strain gauge tests of the principal drilling rig units, such as the mast, crown block, and base were carried out at the Uralmash plant lab and confirmed their reliability. The telescopic drill mast consists of two sections. According to drilling crew reports, the rigs are convenient in operation, are distinguished by high mobility, and can be quickly deployed. Time outlays for deployment and folding up have been shortened by more than twofold compared to similar devices. The drilling rigs will be additionally equipped with gangway bridges for auxiliary operations. Patent No. 144086 has been issued for both rigs. Figures 2; tables 1.

URB-2A-2N Self-Propelled Drilling Rig

917F0350C Moscow RAZVEDKA I OKHRANA NEDR in Russian No 3, Mar 91 pp 29-31

[Article by V.I. Spirin, S.V. Yakovlev, Kayrakkum Geological Expedition of the Tadzhikgeologiya Production Association]

UDC 622.242.2.055

[Abstract] The shortcoming of existing drilling rigs for sinking 50-300 m deep exploration wells in inaccessible and inhospitable mountainous areas at 60-75° angles is summarized. The design of the URB-2A-2N drilling rig, an upgraded version of the URB-2A-2, is described. The rig makes it possible to sink wells at 50-90° angles to 300 m depth with a 59 mm borehole diameter and to a depth of 400 m with a 46 mm borehole diameter at a drill bit speed of 900 min^{-1}. The modifications made in the original drilling rig are described and its specifications are cited. Two years of the URB-2A-2N operation have proven it to be reliable and have high off-road capabilities in the mountains. It is shown that despite some drawbacks, the use of the new drilling rigs makes it possible to achieve considerable savings since it eliminates the need for some types of road construction. Figures 1; tables 1.

Assessing Rock Massif State by Drill Core

917F0350B Moscow RAZVEDKA I OKHRANA NEDR in Russian No 3, Mar 91 pp 25-28

[Article by A.A. Donchuk, All-Union Science Research Institute of Hydrogeology and Engineering Geology]

UDC 624.131.1.25:553.3/4:550.812

[Abstract] The study of rock and mineral resources by drill cores in engineering geology research carried out while prospecting for solid minerals is addressed. It is shown that data obtained from the drill core make it

possible to develop a geomechanical rock mass model which includes geological parameters and engineering properties of rock, such as strength, deformation, etc. The model's geological parameters encompass the boundary conditions, i.e., petrographic and lithographic rock properties and their distribution, the type, orientation, distribution, and other features of fault surfaces (dislocations); groundwater distribution and chemical and physical properties, etc. Among said geological properties, fault surfaces of various origin, such as fractures, cracks, jointing, cleavage, stratification planes, layers, weak rock seams, etc., play the most important role. Ten criteria characterizing fault surfaces and methods of identifying them in drill cores are discussed. The *RQD* indicator, i.e., the total core yield in a core equal to or exceeding 0.1 m expressed as a percentage of the run, is described. It is shown that the methods of estimating a rock massive by the jointing indicator and other criteria based on simple operations with rock drill cores can be widely implemented in prospecting and geological exploration. References 5: 1 Russian; 4 Western; figures 2; tables 3.

Outlook for Developing Mining Equipment for Rare Metal Mines

917F0349B Moscow GORNYY ZHURNAL in Russian No 5, May 91 pp 54-58

[Article by V.N. Mosinets, G.M. Dragan, P.P. Kharitoshin, V.I. Badin]

UDC 622.272:658.27.002.237:553.493

[Abstract] The changing geological mine conditions in recent years and especially a sharp increase in ore deposits in steeply sloping low-depth ore bodies which necessitate changing standards and sizes of excavating machines, particularly a range of small-scale excavating machines, e.g., self-propelled shaft drilling rigs (UBSh) and loading-hauling machines (PTM), are identified. Principal distinctions between the newly developed mechanization facilities and existing machines are summarized and engineering aspects of mechanizing the drilling, loading and hauling, and auxiliary operations are considered. Prototypes of drilling (UBSh-2G), loading and hauling (PT-2ESh), and auxiliary (MVN) machines developed for rare metal mines and their specifications are described. The new machines meet the requirements of today's mining science and engineering. Their implementation will make it possible to reduce the ore impoverishment by 20-40%, reduce the rock mass excavation volume by 25-30%, and lower the cost of ore processing operations. Specifications of foreign and domestic mining machines are compared. Rare metal mines are being retrofitted on the basis of the new domestic machines. Figures 1; tables 5.

New Uralmashzavod Excavator

917F0349C Moscow GORNYY ZHURNAL in Russian No 5, May 91 pp 59-61

[Article by M.V. Kurlenya, A.R. Mattis, G.Kh. Boyko, V.N. Tsvetkov, A.V. Tolmachev, Mining Institute at the Siberian Branch of the USSR Academy of Sciences]

UDC 621.879+622.23.05

[Abstract] A new EKG-5V excavating machine with an active action bucket, i.e., a first quarry excavating machine in the world whose bucket is equipped with impact teeth which break the rock layer by layer in the stope, making it possible to excavate the rock mass from the pillar without preloosening it thus eliminating the drilling, blasting, secondary crushing, and accompanying auxiliary operation is described. The new machine began pilot operation in November 1990 in a Nizhniy Novgorod oblast quarry. The patent search which preceded the excavating development and was conducted by the Mining Institute revealed more than 200 similar foreign patents. The excavating machine was designed and manufactures at the Uralmashzavod plant production association following many years of studying the impact layer-by-layer rock fracturing process. Excavating machine specifications are summarized and the results of its tests are cited; the tests confirmed the conclusions drawn earlier that it would help to excavate rock without preloosening. The excavator has an output of 300 m^3/h and is suitable for 60% of domestic nonferrous and rare ore deposits. Its commercial production is expected to commence in 1992. References 4; figures 2; tables 1.

Improving Drilling and Blasting Equipment and Technology

917F0349A Moscow GORNYY ZHURNAL in Russian No 5, May 91 pp 10-14

[Article by I.F. Matveyev, A.F. Myunkh, Yu.M. Karapetyan, B.V. Pokrovskiy, I.V. Mashukov, Tashtagol Mining Administration]

UDC 622.235

[Abstract] Traditional blast hole drilling techniques employing heavy machines and perforators which have been used in the past several decades and their low output and shallow drilling depth as well as other shortcomings are summarized. The working of deposits by a system of subdrifts (cross-cuts) with blast holes and explosive (VV) charge wells drilled in a grid of level (METs) and interchamber pillars (MKTs) and the specific blast hole and charge arrangement, a version of the method of induced caving, the use of underground crushing, and other drilling and blasting techniques are reviewed. A program of comprehensive automation of drilling and blasting operations and a complex of equipment for mechanizing blasting operations and its specific components are described. The complex was tested at a

Tashtagol Mining Administration mine in 1978. In addition, the design of a gravity feed system for delivering loose explosives to mines and a hauling and charging machine is presented. The layout of a proximate parallel blast hole arrangement is cited. The need to improve the drilling and blasting technology so as to increase the rock crushing degree, reduce the oversize yield to 1-2%, and lower the specific explosive consumption for secondary crushing to 0.02-0.03 kg/t by using larger diameter holes (250-300 mm), efficient explosive charge positioning schemes in stressed and strained rock, and other measures is identified. References 6; figures 4.

Determination of Natural Frequencies and Equivalent Masses of Elastic Body on Basis of Its Dynamic Compliance

917F0198B Leningrad VESTNIK LENINGRADSKOGO UNIVERSITETA, SERIYA 1: MATEMATIKA, MEKHANIKA, ASTRONOMIYA in Russian No 4, Oct 90 pp 35-42

[Article by V.N. Vernigor]

UDC 624.07:534.1

[Abstract] An approximate method of calculating the natural frequencies and the equivalent masses of an elastic body is proposed, this method requiring only and analytical or experimental determination of its dynamic compliance at various excitation frequencies. Assuming that a set of forces is acting on such a body, vibrations of its point $A(x_A,y_A,z_A)$ in the direction of unit vector i_A are referred to a Lagrangian system of coordinates 0xyz. By virtue of the superposition principle, the problem reduces to one of calculating the displacement $\xi_A(t)$ of point A in the i_A direction as a function of time while a concentrated force $P = P(t)i_B$ also varying in time is acting at some other point B in the direction of an arbitrary unit vector i_B. The displacement vector $\xi(x,y,z,t)$ of any point can be resolved into two components, one representing displacement of a given point as that of an ideal solid body and one representing its displacement due to deformation of the body. Only the latter component is of concern here and is described by the vector equation of motion in the approximation of small vibration amplitudes $\rho\xi$ (second derivative with regard to time) - $(\lambda + \mu)$grad div ξ - μ del^2 ξ = $\delta(x_B-x)\delta(y_B-y)\delta(z_B-z)$ $P(t)i_B$ (ρ- density of solid material, λ,μ- Lame constants, δ- Dirac's delta function). Its solution is sought in series of natural modes $\xi_\nu(x,y,z)$, the characteristic vector equation $(\lambda + \mu)$grad div $\xi_\nu + \mu$ del$^2\xi_\nu$ = $\rho\omega_\nu^2\xi_\nu$ yielding the natural frequencies ω_ν for any specific boundary conditions. Application of the Fourier method for zero initial conditions then yields an expression for displacement $\xi_A(t)$

$$\xi_A(t) = \xi(x_A, y_A, z_A, t)\cdot i_A = \sum_{\nu=1}^{\infty} \frac{1}{M_\nu \omega_\nu} \int_0^t P(\tau) \sin \omega_\nu (t-\tau)\, d\tau,$$

which involves the equivalent masses M_ν. Inasmuch as the ratio (sup tilde)$\omega_A(t)$/P(sup tilde)(t) is the dynamic compliance R(ω) ([sup tilde]$\omega = \omega_0 e^{j\omega t}$ and [sup tilde]$P_0 e^{j\omega t}$ being harmonic functions), the latter can now be expressed as

$$R(\omega) = \sum_{\nu=1}^{\infty} \frac{1}{M_\nu (\omega_\nu^2 - \omega^2)}.$$

It then remains to determine R(ω), which is done by resolving it into a sum of simple fractions and approximating it with the expression

$$R(0) - \sum_{\nu=1}^{N} \frac{1}{M_\nu \omega_\nu^2} + \sum_{\nu=1}^{N} \frac{1}{M_\nu (\omega_\nu^2 - \omega^2)}$$

The natural frequency of mode n and the effective mass for this mode can now be calculated when $R_n(\omega)$ as well as ω_ν = 1,2...,n-1 and M_ν = 1,2...,n-1 are already known. The method is validated by two theorems pertaining to natural frequency and effective mass of a mode n, both theorems being proved here. References 9.

Level of Self-Induced Vibration in Aerodynamic Control Surfaces Subjected to Transonic Airflow

917F0257A Kiev PROBLEMY PROCHNOSTI in Russian No 4, 1991 pp 51-55

[Abstract of article by A. V. Safronov, Kiev]

UDC 629.7.015.4:533.6.011,3

[Abstract] The author presents a set of equations that accounts for all the determining factors responsible for the origination and development of self-induced vibrations in aerodynamic control surfaces subjected to transonic airflow with shock waves. This set of equations can be used to estimate the level and limiting cycle amplitude of self-induced vibrations in symmetrical control surfaces under the airflow conditions described. Figures 2; references 12: Russian.

Method of Mapping Motion of Walking Machine Over Intricate Terrain

917F0232A Moscow PROBLEMY MASHINOSTROYENIYA I NADEZHNOSTI MASHIN in Russian No 2, 1991 pp 35-40

[Article by A.V. Bogutskiy, Moscow]

UDC 531.8+519.8

[Abstract] Planning the motion of a walking machine over an intricate terrain involves constructing a law of motion for the torso and for the legs in absolute space. In this case it is not sufficient to design algorithms which will ensure stepping on a succession of track points recommended by the operator, but also necessary to adaptively correct the choice of track points and especially so when a multilegged walking machine is cover a terrain not accessible to or at least not yet covered by a human being. A method of such an adaptive correction of the "initial" set of track points is proposed, assuming that the machine moves in a quasi-statically stable mode with its center of mass remaining located within a small ε-vicinity about the center of mass of its torso during any configuration of its legs. The orientation of the torso is assumed to remain invariable and all legs are assumed to move within convex spaces so that the spaces of any two legs do not intersect. The principle of this method is addition of new track points to the "initial" set so as to ensure a connection of paths, the correction criterion being to make the given sequence of transitions possible. The algorithm of this correction method, programmable on a navigation computer, is demonstrated on a walking machine which will tread over an arbitrary terrain so that its legs will only step on spots where they can stand and avoid spots where they cannot. A typical trajectory of such a motion is shown in the plan view. Figures 2; references 3.

Creation of High-Power NC Hydraulic Presses for Shipbuilding

917F0290A Leningrad SUDOSTROYENIYE in Russian No 3, Mar 91 pp 42-43

[Article by A.N. Khaustov under the "Shipbuilding and Machine Building Technology" rubric: "Creation of High-Power NC Hydraulic Presses for Shipbuilding"; first paragraph is italic SUDOSTROYENIYE introduction]

UDC 621.981.1.06-82

[Text] *The 1990 USSR Council of Ministers Prize in the field of science and technology was awarded to I.P. Bogdanov, O.S. Kuklin, A.F. Poletayev, and I.G. Shirshov for their work entitled "Creation of an Array of Numeric Control [NC] Hydraulic Sheet-Stamping Presses With Forces of 4,000, 8,000, and 12,500 kN and Their Wide-Scale Introduction Into Industry." Scientific research and experimental design work on this theme has been conducted for a number of years at the Central Scientific Research Institute of Shipbuilding Technology and the Dnepropetrovsk Production Association, which have worked with shipbuilding plants to produce heavy presses.*

Bending the sheets of a hull's skin is one of the most labor-intensive operations in shipbuilding. It is therefore no accident that scholars have directed their efforts toward making this very technological process easier. The following task has been set in creating presses of this type: to automate the cold bending of large sheet blanks to produce components for the skin of a ship's hull having a complex shape (including hulls having variable-sign curvature, rectilinear and curvilinear generatrixes) and to automate the bending of the end sections of the sheets before producing cylindrical or conical components on sheet-bending roller machines.

The new presses are distinguished by the single-column cantilever structure of the frame and the increased parameters of their working space. These features make it possible to manufacture base members of significant overall dimensions on them. When compared with the two-column (gantry) design of presses intended for similar purposes, one-column presses provide access to the live zone from three sides. This is very important when machining large blanks whose dimensions extend beyond the bounds of the live zone. As has been demonstrated by the experience of operating gantry presses with a ram and die moving along the gantry, the presence of a gantry constricts the space required for free manipulation of the blank during the process of bending large complexly shaped components. This is particularly true in the case of V-shaped components whose bend line is displaced from the center to the edges of the sheet in the form of rays, and the blank must be turned on the table. Such components are needed to shape rims in a region of the stern end and nose. When a gantry press is used, such blanks must be cut in the part with small overall dimensions.

Single-column presses are free of yet another common flaw of gantry presses. When the ram and die move along the gantry, the permissible force drops sharply as the distance from the center of the span increases. For example, the force at the center of the gantry of presses produced by the Swedish firm Karbox amounts to 30,000 kN but decreases to 8,000 kN at the edge. As a result, despite the significant power of such equipment, its technological capabilities from the standpoint of permissible thickness of very wide blanks to be machined must be estimated not based on the maximum but rather on the minimum developed force. For this reason, shipbuilding enterprises have established identical maximum permissible thicknesses of large workpieces, i.e., 76 mm, for a gantry press with a force of 30,000 kN and a mass of 350 t (without any consideration for the manipulators) and for the newly developed PA3241F1 single-column press, which develops a force that is less by a factor of 2.4 (i.e., 12,500 kN) and which weighs less.

Also noteworthy is the fact that single-column presses are less sensitive than gantry presses toward eccentricity of the load arising during bending.

The more extensive technological capabilities of the newly developed presses, which surpass both the parameters of gantry and conventional cantilever presses, may be illustrated by the following examples.

The area of the working surface of the pullout table of the PA3239F1 press, which develops of force of 8,000 kN, is larger than the analogous press produced by the German firm Wilgelmsburger by a factor of 4.3 (3,600 x 2,600 mm versus 1,800 x 1,200 mm), the maximal run of the vertical and side cylinders is larger by a factor of 2.1 (1,200 and 1,300 m respectively versus 550 and 600 mm), and what has been termed the open height is larger by a factor of 2.2 (2,200 mm versus 1,000 mm). The increased dimensions of the working space of similar equipment has helped the shipbuilding industry switch over to manufacturing large base members, which in turn makes it possible to form larger sections. The length of the welds is reduced, and the specific labor input and amounts of welding materials required are also reduced accordingly. The adjustment operations required when assembling structures are also easier. The increased reliability of ships having a lesser number of welded joints must obviously be emphasized.

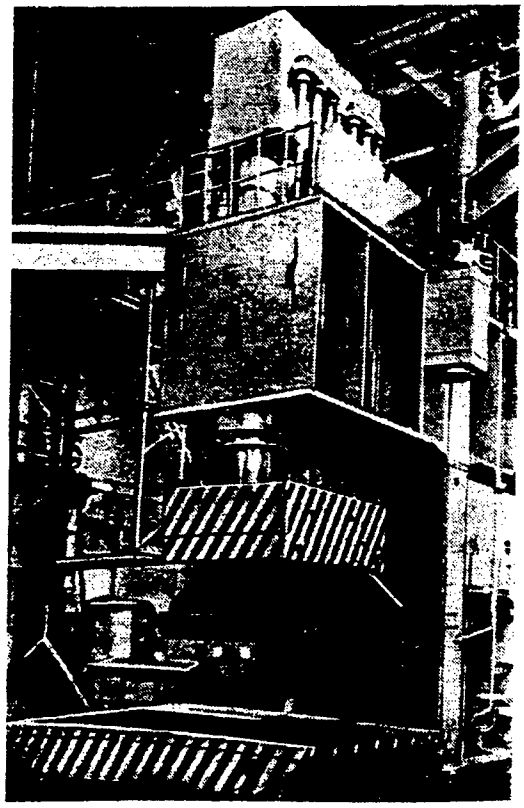

Figure 1. The PA3239F1 NC Sheet-Bending Press, Which Develops a Force of 8,000 kN and Which Has Been Installed at the Severnaya Verf [Northern Shipyard] Shipbuilding Plant in Leningrad.

These advantages must, however, be "paid for" by the increased mass of the equipment and the complication of the design of the press' bed frame. Other contributing factors in this respect are as follows: two working rams instead of the one in the analogue (they expand the press' technological capabilities by performing the operations of flanging and stamping sequentially by two rams), the presence of a pull-out table, a blank knockout, additional service areas on the upper crosspiece to safeguard those working at a height, and (finally) a numeric control system. The presses are outfitted with two beam-track-and-trolley hoists with capacities of 3 and 5 tons to feed blanks into the live zone and move the finished components.

The generalized mass indicator established by the USSR State Committee for Standards (specific mass), which by and large gives consideration to the technological capabilities of presses, nevertheless turned out to be lower than that of foreign analogues. A press developing a rated force of 8,000 kN thus has a specific mass of 5.326 (versus 6.8 for a similar press manufactured by the firm Wilhelmsburger), and a press developing a force of 12,500 kN has a specific mass of 5.2 (versus 5.9). The mass of the presses developed thus corresponds to their high consumer qualities.

Table 1. Key Technical Data on the Presses

Parameter	PA3236F1	PA3239F1	PA3241F1
Rated force, kN	4,000	8,000	12,500
Force of cylinders, MN			
vertical	2 x 2.0	2 x 4.0	2 x 6.25
side	1.0	2.0	3.15
pusher	1.0	2.0	3.15
Working surface of table, mm	2,000 x 2,400	2,600 x 3,600	3,000 x 4,500
Open height, mm	1,800	2,200	2,200
Run of vertical cylinders, mm	1,200	1,200	1,200
Installed power of electric motors, kW	78.4	127.4	133.59
Press' overall dimensions in a plane, m	6.5 x 9	7.5 x 10.4	8 x 12.2
Mass, t	82	180	320

The presses' NC system is based on devices and electronic microprocessors that are series-produced by the domestic industry. It programs power stroke (bending)

with an error not exceeding 0.5 to 1 mm and graduated control (four ranges) of the ram's motion during the bending process. The required data are specified on a control panel. It should be noted that there is still no software permitting automatic bending of the most complexly shaped components. This is because the small series sizes in which such ships are manufactured and because the low degree of repetition of such components make this software unfeasible from an economic standpoint. Humans are therefore not completely excluded from the process of manufacturing bent components; however, the efficiency of the manufacturing cycle is increased significantly when the newly developed equipment is used. The built-in NC system sets such parameters as the ram's movement during each bend and the magnitude of a blank's elastic recoil. The movement of the end-effector is then repeated precisely with an allowance for elastic springback. This ensures that the dimensions and shapes of all the components in a batch will be identical. The tool's movement is also controlled by a digital indicator. In the shipbuilding industry, the use of a fairly simple and rather inexpensive NC system is the optimal solution for presses intended for such purposes. An NC system is highly reliable to use and simple to set up.

The precision of large base members manufactured on the new presses is increased 30 to 40% when compared with those manufactured by the conventional technology with visual inspection of the process, and labor productivity is increased by a factor of 1.3 to 1.4. A set of auxiliary devices and attachments makes it possible to eliminate heavy manual labor when servicing the equipment.

Especially important to consumers is the fact that sets of originally designed universal dies to bend components from sheets and profiles of virtually all sizes, shapes, and overall dimensions have been developed. These dies provide optimal conditions for bending edges and machining the center sections of blanks with lined and local application of forces. More than 20 inventor's certificates have been obtained for the bending techniques and die designs.

The design of the presses is protected by USSR inventor's certificate No 979171. The presses are currently being series-produced and are being supplied to a number of shipbuilding enterprises both here and abroad.

Scientific-Industrial Association's Central Boiler and Turbine Institute: Reliable Partner in International Cooperation

917F0234A Moscow TYAZHELOYE MASHINOSTROYENIYE in Russian No 1, Jan 91 pp 16-17

[Article by V.K. Ryzhkov, general director, and V.V. Krug, department head, Scientific-Industrial Association Central Boiler and Turbine Institute]

UDC 341.24:621.18

[Abstract] The NPO TsKTI (Scientific-Industrial Association Central Boiler and Turbine Institute) is now engaging in bilateral and multilateral trade negotiations with industrial enterprises in Western countries (including Japan) and in Middle East countries (Israel, Syria), just as it has been successfully doing and continues to do with industrial enterprises in East European countries, various reciprocal agreements having been reached with regard to delivery and installation of power plant equipment. Possessing the technology and the facilities, the NPO TsKTI can produce, test, and deliver pipes as well as other boiler and turbine components which meet stringent customers' requirements. It does, in exchange, acquire equipment it does not manufacture. One example is pipe testing for creep and durability under internal pressure according to the "yield before fracture" program for the Finnish "IVO" Enterprise. Another example is use of surfactant microadditives according to the TsKTI technology for improvement of power equipment reliability and economy in Germany's Bruno Leuchner nuclear power plant complex with VVER water-cooled water-moderated power reactors, and delivery of TsKTI ion concentration meters in exchange for German-made conductometers. Meanwhile TsKTI scientists and engineers are participating in international organizations and conferences such as the SIMAC Gas Turbines Section. Regarding steam turbines, the NPO TsKTI proposes to design an algorithm for diagnostic turbine vibration testing, also to calculate forced vibrations and estimate stability limits of turbine runners. Items developed by the NPO TsKTI applicable to steam turbines and available to foreign partners on a contractual basis include active cooling of high-pressure cylinders during near-nonflow startup and shutdown conditions, diagnostic erosion tests for runner blade rings, and instrumentation for monitoring steam wetness during turbine operation. Figures 2.

Horizons of Cooperation

917F0234B Moscow TYAZHELOYE MASHINOSTROYENIYE in Russian No 1, Jan 91 pp 18-19

[Article by G.A. Filippov, corresponding member, USSR Academy of Sciences, director, and V.I. Volkova, department head, All-Union Scientific Research Institute of Analytical Machine Design]

UDC 339.92:621.311.22/25

[Abstract] The restructurization ("perestroyka") of relations between the USSR and other countries regarding economic and scientific-technical interaction has profoundly changed the mode of cooperation between the VNIIAM (All-Union Scientific Institute of Analytical Machine Design) and foreign partners in the same field and including solution of problems effecting third world countries. These changes are manifested in much faster contract negotiations and much faster delivery schedules

with much more closely integrated programming and supervision of research and its practical application. One important area where this is being felt very strongly is construction and operation of nuclear and thermal electric power plants, one example being improvement of power equipment reliability and economy in Germany's Bruno Leuchner nuclear power plant complex based on the TsKTI surfactant technology. There are other examples of cooperative effort in this particular field, with various American and French manufacturers on the one hand as well as with Czechoslovak and Bulgarian utilities on the other. While problems of nuclear power plant safety and competitiveness are studied under auspices of the International Atomic Energy Agency, a Hungarian "Fourth of April " team is collaborating with specialists from the VNIIAM and the "Krasnyy Kotelnik" (Red Boiler Master) Industrial Association in projects such as development of ionite counterflow filters for Tkvarcheli and Srednyy Ural (Central Ural) state regional electric power plants.

Foreign Firm Participation in Passenger Car Production

917F0346A Moscow TYAZHELOYE MASHINOSTROYENIYE in Russian No 3, Mar 91 pp 33-34

[Article by V.V. Maslov, Passenger Car Building State Production Association]

UDC 341.24:629.1-46

[Abstract] Production of all types of passenger cars is concentrated in the hands of USSR Heavy Machine Building Ministry enterprises which comprise the passenger car building state production association (GPO). It is shown that although many foreign firms are ready to take part in upgrading passenger car works or building new ones using today's technologies and well-proven car designs, this form of participation requires considerable convertible currency outlays in the initial stages and must therefore by organized in the framework of a state program. Several proposals for joint production of wheel pairs for Japanese and German passenger cars, subway construction in Turkey, the use of induction motor drives for subway cars, and joint Soviet-German production of comfortable railroad cars for export to third countries are summarized.

Chief Designer of Riga Car Building Works

917F0346B Moscow TYAZHELOYE MASHINOSTROYENIYE in Russian No 3, Mar 91 pp 35-36

[Article by V.V. Novarro, Riga Branch of the All-Union Scientific Research Institute of Car Building]

[Abstract] The career path of Edvard Rolandovich Kalnins, Chief Designer of the Riga Car Building Works, is described. Mr. Kalnins graduated from the Belorussian Railroad Engineers Institute and joined the staff of the Riga Car Building Works in 1960. He participated in the development of many new diesel and electric car designs, including the DR2 diesel train, AR1 railway motor car, ER6, ER7, and ER10 pilot electric trains, ER2, ER9, and ER9P DC and AC trains, DR1A diesel train, and ER25 electric train intended for export to Bulgaria. Mr. Kalnins directed the group of designers who developed the truck for the ER200 high-speed electric train which was the first in the country to reach a speed of 200 km/h in 1974. Mr. Kalnins was appointed to his present post in 1975. Since that time he has guided the development and commercial production of ER9M and ER9Ye AC trains, ER2T DC train, ER31 and ER33 electric trains for export to Yugoslavia and Bulgaria, and a new generation of ER29 DC trains and ER30 AC trains. E.R. Kalnins who is 54 years old has several patents and has been awarded the title of Distinguished Railwayman. He is expected to play an important role in guiding his plant's transition to a market economy.

Tests of Powerful Diesel Locomotives

917F0345B Moscow TYAZHELOYE MASHINOSTROYENIYE in Russian No 4, Apr 91 pp 32

[Article by G.I. Maslov, USSR Ministry of Heavy Machine Building]

[Abstract] The railroad transport section of the scientific-engineering council of the USSR Heavy Machine Building Ministry evaluated test results of prototypes of 2TE136 and 2TE126 double-unit 2x4,413 kW 92x6,000 hp) diesel locomotives intended for pulling heavy freight trains in areas with temperate and cold climate; each unit is capable of replacing double-unit 2TE10 and 2TE116 diesel locomotives. The 2TE126 locomotive is distinguished from the 2TE136 by a heavier yet less augmented 16-cylinder ChN 32/32 diesel engine instead of the 20-cylinder ChN26/26 diesel engine. The new ChN 26/26 diesel engine design made it possible to increase the locomotive efficiency by a 1.5-2 times by increasing the freight train mass to 9,000 t, reducing the specific metal consumption by 25-30%, and lowering operating and maintenance costs; this made it possible to increase the warranty run by 1.5 times and realize a 520,000 ruble gain. Acceptance tests of the 2TE136 locomotive are underway.

Series 9000 ISO Standards and Rise in Car Building Export Potential

917F0345C Moscow TYAZHELOYE MASHINOSTROYENIYE in Russian No 4, Apr 91 pp 32-35

[Article by V.A. Pukh, M.I. Natovich, A.M. Berezovskiy, V.T. Malashenkov, All-Union Science Research Institute of Railroad Car Building]

UDC 061.25[083.74]:629.4

[Abstract] The stiffening of quality requirements being imposed today on domestically built railroad cars due to the transition to a market economy and the development of market mechanisms in the country is discussed. It is shown that the quality factor will become decisive for competing in the world market and will have to be taken into account by railroad building enterprises which are manufacturing or planning to manufacture cars for export. The differences between railroad car specifications for the domestic and export market due to operating conditions and technical parameters of railroads, such as the gauge, overall dimensions, climatic conditions, etc., are identified. The importance of adhering to series 9000 ISO standards used in FRG, Great Britain, France, Sweden, Finland, USA, and other countries in order to export railroad cars is stressed and differences and similarities between domestic and international standards are summarized. A range of measures for implementing ISO standards by improving existing regulations governing integrated product quality control systems (KS UKP) is outlined. References 6; figures 1; tables 1.

Estimating Longitudinal Dynamics of Tank Containers on Railroad Flat Cars

917F0345A Moscow TYAZHELOYE MASHINOSTROYENIYE in Russian No 4, Apr 91 pp 7-8

[Article by G.I. Bogomaz, D.D. Mekhov, Yu.V. Demin, M.N. Zaks, G.M. Chernyavskiy, V.M. Bubnov, Mechanical Engineering Institute at the Ukrainian Academy of Sciences, All-Union Science Research Institute of Railroad Car Building, and Azovmash Production Association]

UDC 625.245.6:532.59

[Abstract] Specific requirements imposed on flat car-mounted container tanks for liquid cargo and various container tank designs for storing and shipping different types of liquid cargo are summarized. It is shown that designs of container tanks must be developed allowing for their hydrodynamic loading characterizing the operation of railway transport, primarily automatic coupling shocks. The effect of liquid cargo vibrations in 24-ton container tanks (of standard ICC sizes) on the longitudinal dynamic loads developing during the flat car collision with other cars is examined theoretically on the assumption that collisions occur on a horizontal track section and vibrations of the flat car with the container tank - in the vertical longitudinal plane of its symmetry. The cases of flat cars with one or three container tanks are considered. Design parameters of container tanks for gasoline and nitric acid are compared. It is shown that under real operating conditions, container tank acceleration may reach $2g$. The issue of placing additional shock absorbing elements is addressed. References 5; tables 4.

Structure and Mechanical Properties of R65 Rails Bulk Quenched in Oil

917F0347B Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 4, Apr 91 pp 45-47

[Article by D.K. Nesterov, N.N. Razinkova, L.Ye. Chernyakova, B.S. Kisil, Ukrainian Science Research Institute of Metallurgy]

UDC 620.18:620.17:625.143.2

[Abstract] Characteristic features of structure formation, distribution of mechanical properties, and impact strength in the metal cross section of quality class I and II R65 rails (state standard GOST 24180-82) oil quenched in bulk with subsequent tempering at the Kuznetsk Metallurgical Works (KMK) are investigated. The study was prompted by modifications 1-4 made in state standards GOST 24182-80 and GOST 18267-82 governing the production of quench hardened quality class I rails from steels with an elevated silicon content. Studies were carried out in rail samples from four smeltings two of which had a high carbon content (0.77-0.78%) and two - an average content (0.73-0.74%) with relatively similar concentrations of the remaining chemical elements. The distribution of mechanical properties, impact strength, and structure were determined in cross section elements after rolling and delayed cooling, after oil quenching at 820°C, and after temper hardening from 450° for 2 h. Mechanical properties were measured by tensile tests in an IM-12 machine and MK-30 impact testing machine. Metallographic studies were made in a Neofot-2 microscope and Tesla BS-513A electron microscope. An analysis of the results shows that the structure and property distribution irregularity in the rail cross section are the greatest at a carbon concentration of $\geq 0.76\%$; the head metal microstructure is mixed and nonequilibrium; at the base, the structure consists primarily of tempering products of martensite, pearlite, and bainite with retained austenite. A need for further studies in order to develop an optimum chemical composition of rail steel and bulk rail quenching conditions is identified. V.N. Yermolayev, A.D. Khodarovskaya, N.A. Bedenko, T.I. Letko, I.P. Strokov, T.P. Gulyayeva, G.N. Tarasov, and N.I. Bedarev participated in the study. References 7; figures 3; tables 2.

Investigating Feasibility of Using Na-Carboxymethylcellulose Polymer Medium for Rail and Rail Fastener Part Quenching

917F0347A Moscow METALLOVEDENIYE I TERMICHESKAYA OBRABOTKA METALLOV in Russian No 4, Apr 91 pp 24-27

[Article by A.V. Zakharov, Yu.E. Eysmondt, L.P. Shcherbakova, E.L. Kolosova, T.A. Trunina, Urals Polytechnic Institute and Urals Science Research Institute of Ferrous Metallurgy]

UDC 621.78.063:669.14.018.294.2

[Abstract] The use of various polymer quenching media and their economic and ecological impact are discussed and the development of a new solution of a sodium salt of carboxymethylcellulose (Na-KMTs) intended to replace quenching oils is reported. Experiments aimed at estimating the cooling ability of the new medium and the results of experimental bulk quenching of full-section R65 rail samples and fasteners (R65 and 1R65 cover plates) in Na-KMTs solutions of various concentrations are described. Standard composition M76 and M74 steels were used in the experiments. The cooling ability of Na-KMTs solutions were determined by the cooling curves of a cylindrical thermal probe from Kh18N9T steel. An analysis of experimental data indicates that Na-KMTs polymer-based media are more sensitive to the quenching temperature increase than the PK-2 medium used before; an increase in the Na-KMTs aqueous solution's temperature leads to significant drop in the heat transfer coefficient with the pearlite transformation temperature range. After quenching in a 2.0-1.5% solution of Na-KMTs, rails acquire a range of properties and structure which are similar to the characteristics obtained after bulk quenching in oil. The properties and structure of rail plates after quenching in a 0.5% aqueous solution of Na-KMTs meet the requirements of specifications TU 232-49-89. References 7; figures 3; tables 3.

Issues of Wide Strip Mill Upgrading

917F0340A Moscow STAL in Russian No 5, May 91 pp 42-45

[Article by A.V. Tretyakov, Central Advanced Metallurgist Training Institute]

UDC 621.771.23

[Abstract] Problems affecting some Soviet rolling mills which are rapidly aging and becoming obsolete are identified; it is shown that partial or even total upgrading would not make sense economically while existing physical facilities and personnel are valuable and must be utilized. The development of new machines and processes for producing blanks whose cross section and dimensions are close to those of finished products by utilizing advances in continuous casting machines (MNLZ) and methods and combining these machines with strip mills is addressed. The Compact Strip Production (CSP) process developed by the SMS Schloemann-Siemag company for making a continuous 40-50 mm thick, 1,200-1,600 mm wide blank at a pulling rate of 5-6 m/min is reported and compared to similar foreign designs used in Germany, the United States, and Japan. It is stated that these examples of new technologies must be incorporated in developing a modern concept for retrofitting wide strip mills; it is shown that in so doing, it is necessary to try to combine the process of continuous casting with rolling thus shortening the metallurgical production cycle and producing considerable economic gain; it is speculated that continuous casting of thin slabs and strips will probably result in changing the design of hot rolling mills and maybe even phasing them out altogether. Such efforts would make it possible to utilize existing staff and facilities and increase the strip production efficiency and level in a short time. References 2; figures 2.

Mechanism of Boiler Pipe Failure and a Magnetic Method of Detecting Sections of Pipe Most Prone to Failure

917F0250A Kiev TEKHNICHESKAYA KONTROL in Russian No 2, 1991 pp 34-37

[Abstract of article by A. A. Dubov, Candidate of Technical Sciences]

UDC 621.791.052:658,562

[Abstract] A magnetic non-destructive testing method was developed to detect sections of boiler pipe that are likely to become weak and rupture due to elevated stress concentrations and to the inability of these sections of pipe to compensate for these concentrations. The method utilizes the residual magnetization that comes to the surface of the metal as a result of the plastic deformation that occurs in pipe surfaces when temperature compensation is insufficient. Magnetic stray field strength in sections of boiler pipe with elevated stress concentrations is measured with a ferromagnetic probe positioned perpendicular to the axis of the pipe being tested, and characteristic stray fields are recorded in those places where the pipes have weakened. When this method was used to test TGM-96 boiler pipe at a Mosenergo power station, it was found that the vector of stray magnetic field strength, H_s, forms a nearly 45°-angle with both the contour and the axis of the pipe in those places on the pipe surfaces where plastic deformation has occurred, and that, within a short section of test pipe, there is a spike in the value for H_s ((0.5 to 1) d_n, where d_n is the external pipe diameter). The measurements were taken repeatedly and were highly reproducible. Thus, measurements of magnetic stray fields that reveal spikes in H_s within a short section of pipe can be used to find those places where the state of stress is making a boiler pipe susceptible to rupture. Figures 3; references 6: Russian.

Using Radiation-Generated Ultrasonic Vibrations in the Non-Contact Acoustic Inspection of Non-Magnetic Current Conducting Materials

917F0250B Kiev TEKHNICHESKAYA KONTROL in Russian No 2, 1991 pp 51-56

[Abstract of article by V. V. Bogdanov, V. I. Simanchuk, V. L. Chakhlov]

UDC 620.179.16:620.179.15

[Abstract] The possibility of using ultrasonic vibrations generated by pulsed charged particle beams in non-contact acoustical inspection techniques was investigated. A theoretical analysis of the use of pulsed charged particle beams to generate ultrasonic vibrations was summarized. Researchers constructed an experimental non-contact acoustical inspection apparatus utilizing radiation-induced ultrasonic vibrations. The apparatus consisted of a small nanosecond accelerator mounted on an MIRA-2D x-ray apparatus, the main component of which is an IMAZ-150E two-electrode pulsed electron tube, an EMA transducer with a single 7 by 20 by 30-mm permanent magnet, a 12 by 18-mm flat elliptical detector coil made from PEV-0.31 wire, a signal amplification unit consisting of a low-noise wide-band pre-amp and an UZ-29 high-frequency amplifier, and a visual output unit based on an S8-12 wide-band oscillograph. The aluminum specimens were in the form of prisms 40 by 40 by 60-mm and plates 18 mm thick. Three-dimensional defects were simulated by making flat-bottomed holes and rectangular grooves in the specimens and by drilling holes in them from the side. The electron beam generated by the accelerator was aimed at the defect-free surface of a specimen, with the beam axis aligned with the defect axis. A comparison of oscillograms from defect-free and defect-simulating specimens showed that the presence of a defect induces additional intermediate acoustical signals, the position of which on the time axis depends on the depth of the defect. Thus, ultrasonic vibrations induced by electron beams can be used in echo-type non-contact acoustical inspection. The key to detecting the presence of a defect in a specimen is the change in amplitude of the re-reflected echo signals. Figures 5; references 13: 11 Russian, 2 Western.

Ultrasonic Inspection of Seam Welds in Tubing

917F0250C Kiev TEKHNICHESKAYA KONTROL in Russian No 2, 1991 pp 65-73

[Abstract of article by V. A. Troitskiy, Yu. K. Bondarenko, Yu. B. Yeskov, S. A. Myasin, V. S. Zagorulko, A. L. Shekero, A. S. Melnikov]

UDC 621.643.002.5:620.179.16.02

[Abstract] The Ye. O. Paton Institute of Electric Welding of the Ukrainian Academy of Sciences and the All-Union Scientific Research Institute of Tubular Products have jointly developed for the Vyksun Metallurgical Plant an improvised unit and a control algorithm designed to automate the ultrasonic inspection of welded seams in tubing with diameters and wall thicknesses ranging from 530 to 1020 mm and from 8 to 38 mm, respectively. The unit consists of four acoustic generators, two UD82-UA ultrasonic flaw detectors, a control unit, and a computer system. The first and fourth generators, each of which consists of two tilted ultrasonic transducers, are connected to one of the UD82-UA detectors to detect transverse defects, and the other two are connected to the other UD82-UA detector to detect lengthwise defects. During inspection, tubular products are divided into three groups depending on wall thickness, and each group is subjected to X-, K-, or Zh-shaped ultrasound patterns depending on wall thickness and the type of defect being tested for. Test specimens with control reflectors that simulate defects are used to calibrate the generators. Transducers with different lead-in angles are used to allow for different tube wall thicknesses and other dimensions. To ensure that the transducers are in proper working condition, a special device that measures and checks their parameters was designed. The improvised ultrasonic tester and the testing methods described have been subjected to laboratory tests, and the results are being used as the basis for designing an automated ultrasonic testing unit. Figures 10; references 8: Russian.

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